Seasonal forecasts of the Arctic sea ice cover with CNRM-CM5.1 global coupled model

Matthieu Chevallier and Virginie Guemas

CNRS-GAME

Abstract

We use the CNRM-CM5.1 coupled Atmosphere-Ocean Global Climate Model (roughly 50km horizontal resolution in the Arctic ocean) to perform seasonal hindcasts during the period 1990-2010. 5-month ensemble seasonal forecasts of September sea ice annual minimum and March sea ice annual maximum are run from realistic initial conditions on May 1st and November 1st. Initial states are built with the ocean-sea ice component of CNRM-CM5.1. This ocean-sea ice component comprises the ocean physics component of the European NEMO model, coupled with the GELATO dynamics-thermodynamics multicategory sea ice model. Performance of the system in forecasting pan-Arctic Sea Ice Extent (SIE) is assessed by comparing the ensemble forecasts to observational estimates from passive the National Snow and Ice Data Center (NSIDC). Although atmospheric biases lead to a systematic underestimation of September SIE, September SIE anomaly predictions are skilful, with Anomaly Correlation Coefficients (ACC) equal to 0.72 for raw anomalies, and 0.60 for anomalies relative to the long-term trend. This confirms the possibility to produce forecasts of the September sea ice minimum up to 5 months in advance. In Winter, performance are also encouraging with ACC reaching comparable values. Winter forecasts experience negligible drifts, thus predicted March sea ice concentration and thickness distribution may be useful for potential needs. We also found predictability from initial value for pan-Arctic SIE to be significant during the entire forecast lead time, for both September and March cases. We also assess Winter forecasts in the marginal seas. ACC skill scores in the Barents Sea are high and show that our system captures well the processes responsible for sea ice variability in this area up to a few months in advance. In the Bering Sea and the Sea of Okhotsk, predictions exhibit promising skills, which suggests that atmospheric and oceanic freeze-up precursors are correctly initialized in these areas. The present study gives insight into the current ability of state-of-the-art coupled climate systems to perform operational seasonal forecasts of the Arctic sea ice up to 5 months in advance.